

1 ABSTRACT OF THE DISCLOSURE

2 A semiconductor manufacturing process is disclosed that may form a contact
3 structure with a tungsten plug. A contact structure hole may be adequately filled with
4 tungsten, while avoiding plug loss, increased resistance and/or trenching, that can result from
5 conventional approaches. According to one particular embodiment, a titanium film (003)
6 may be deposited with an anisotropic sputtering method, such as an ion metal plasma
7 method, or the like. A titanium film (003) may have a thickness outside a contact hole (020)
8 that is 100 nm or more. However, due to anisotropic sputtering, a titanium film (003) within
9 a contact hole (020) may be thinner than outside the contact hole (020). A contact hole (020)
10 may then be filled with a tungsten film (005). A tungsten film (005) and titanium film (003)
11 may then be etched back leaving a tungsten plug having shape with an upwardly projecting
12 portion.